Manipulation of Fluvial Bathymetry through Yawed Porous Grids

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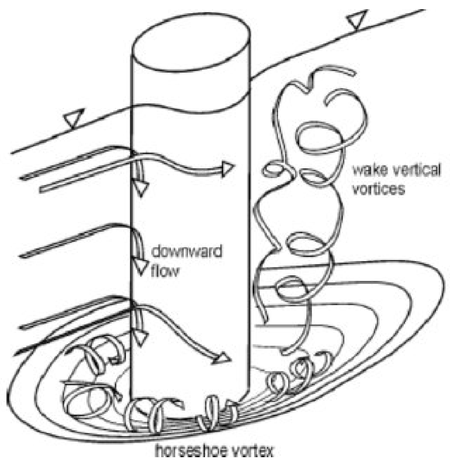
Background

- Sediment transport in a fluvial system is affected by the installation of marine hydro-kinetic devices (MHK), similarly to the transport around a bridge pier
- The transport is affected because of the localized acceleration of the flow around the installed MHK devices



- The localized vorticity leads to a change in particle shear stress, causing sediment transport
- The sediment shear stress around a structure will create near- and far- downstream changes in bathymetry

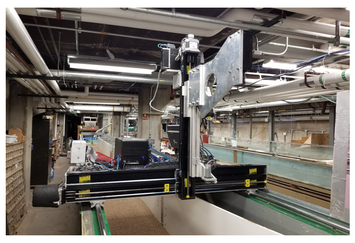
Motivation

- Sediment transport is an important problem in reservoir systems
- Currently reservoirs are periodically flushed to remove the buildup of sediment, disrupting the local ecosystem
- If sediment was able to be directed to a centralized sump system, the flushing could be continuous, and not disrupt the local ecosystem

Methodology

- A porous grid can be used to represent the drag effects of an MHK

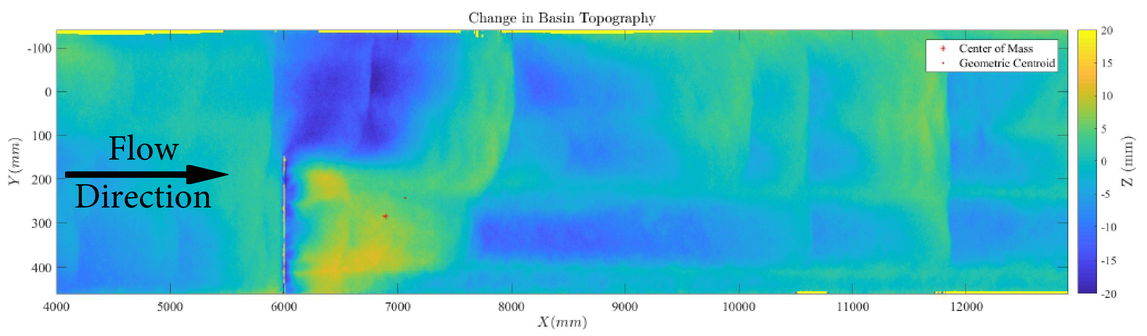
- The porous grid was placed in a erodible bed experimental flume to simulate the installation of an MHK device



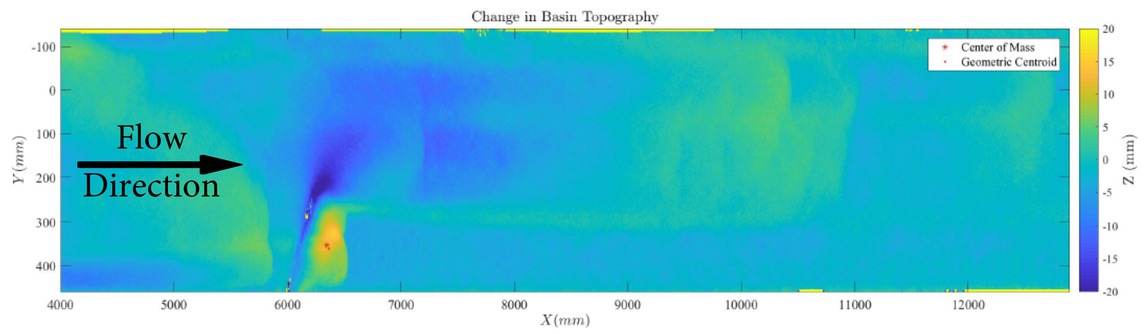
- Bed topography data was gathered using a Data Acquisition Cart (DAC)
- The hydraulic experimental conditions were controlled such that the morphodynamic effects of the porous grid would be accentuated

Analyzing Changes in Fluvial Bathymetry

- The scour and deposition patterns around the grid were measured under two conditions: grid perpendicular to flow and yawed out of the flow



- The center of mass was used to quantitatively describe the location of the downstream deposition



- The scour and deposition patterns are skewed with the yawing of the porous grid under similar hydraulic conditions when compared to the perpendicular grid
- The efficacy of morphodynamic control with the yawing of porous grids can only be determined will further experiments

Future Work

This project will be continued under the UROP award for Spring 2020, and...

- Will examine additional yaw angles of the porous grid, including yawing into flow instead of out of it
- Will compare results to a proposed theoretical model of sediment transport under these conditions
- Will determine an optimal yaw angle to achieve adequate bathymetric control

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